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Use of Landsat Thematic Mapper multi-temporal images to detect and study vegetation dynamics in the Mojave Desert: Applications to studies of dust emission

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Abstract

Remotely sensed satellite, airborne, and ground-based digital images are being used to investigate landscape vulnerability to wind erosion in the Mojave Desert, with particular interest in the detection and mapping of surface change in the Mojave Desert. Land surface parameters critical in determining the vulnerability of the landscape to wind erosion include vegetation type (annual or perennial) and cover, topography, and surface soil properties. Of these the amount of vegetation cover is the most dynamic over relatively short periods of time due to its sensitivity to seasonal and yearly rainfall. Digital change-image maps generated using satellite images collected under different vegetated surface conditions in the Mojave Desert are being used to 1) extract information directly related to the presence of fine-grained sediment (fines) available to wind erosion and 2) map the amount of sheltering of the surface provided by both annual and perennial vegetation. The temporal characteristics of the image data used as input for change detection and analysis are critical, with selection dependent on the main objective of a given study (i.e., short-term seasonal or long-term multi-year change detection).

In our study, Landsat Thematic Mapper images collected during very contrasting precipitation conditions (April 1992/wet El Nino year and June 1997/dry year, as well as spring 2000/dry and spring 2001/wet) are being analyzed to detect and map vegetation dynamics in the Mojave National Preserve. Resulting digital change images are used to help identify and map dust source areas, as well as extract information related to vegetation types and amounts. By analyzing vegetation change affected by both seasonal and highly contrasting climate/rainfall conditions, we extract information that is mostly related to annual vegetation. Dust sources composed of sand intermixed with clay (loamy sand) or clay intermixed with sand (sandy loam) are ideal soils for the growth of annuals, that is controlled primarily by annual rainfall. Using change detection procedures we are detecting and mapping information related to changes in the spatial distribution and cover of annual, as well as some perennial, vegetation in the Mojave National Preserve, and thereby, changes in availability of dust. A direct result of this research is the development of tools and capabilities to characterize surface features and detect surface changes, including the capability to evaluate and monitor the vulnerability of land and vegetation to environmental and climate-induced changes on a regional scale, especially with respect to potential dust emission.